objective and a 2-inch eye-piece. The measured part of the plate is about a foot long, the plates being 19 inches long.

All the spectrum photographs taken at different times coincide perfectly, and this can be used for such problems as the determination of the atmospheric lines. For this purpose, negatives at high and low sun are compared by scraping the emulsion off from half the plates, and clamping them together with the edges of the spectra in coincidence. The two spectra coincide exactly line for line except where the atmospheric lines occur.

This method is specially valuable for picking out impurities in metallic spectra, using some standard impurity in all the substances to give a set of fiducial lines; or, better, obtaining the coincidence of all the metals with some one metal, such as iron. Making the iron spectrum coincide on the two plates, the other spectra can be compared. This is specially possible, because the focus of a properly set up concave grating need not be altered in years of use; for, when necessary, it can be adjusted at the slit, keeping the distance of the grating from the slit constant.

The spectrum of the carbon poles is generally too complicated for use with any thing except the more pronounced lines of metals, there being, at a rough guess, 10,000 lines in its spectrum. However, in photographing metallic spectra, but few of these show on the plate, as they are mostly faint. The spark-discharge gives very nebulous lines for the metals.

Most gratings are ruled bright in the higher orders; but this is more or less difficult, as most diamond-points give the first spectrum the brightest. Indeed, it is very easy to obtain ruling which is immensely bright in the first spectrum. Such gratings might be used for gaseous spectra. Short-focus gratings of five feet radius of curvature, very bright in the first order, require only a fraction of a second exposure for the solar spectrum, and the spectrum of a gas can be obtained in less than an hour. H. A. ROWLAND.

NOTES AND NEWS.

A SCHOOL for boys will open Wednesday, July 3, 1889, at North Edgecomb, Me., and will continue through the long vacation. Its primary object will be to fit boys for the college-admission examinations in the fall; but others who desire to advance in their studies, or to make up deficiencies during the summer, will there find an excellent opportunity. Especial attention will be paid to those who have been conditioned in the spring examinations. The staff of instructors will consist of four Harvard graduates, who are specialists in their several departments, and experienced tutors. The location affords good facilities for tennis and base-ball, as well as for boating, bathing, and fishing. As an experienced man will have special charge of the out-of-door sports of the students, a few boys will be received who do not wish to study, but who desire to pass the summer, or a portion of it, in a pleasant and healthful locality which combines country and seashore advantages. For further particulars, address Louis L. Hooper, Harvard University, Cambridge, Mass.

— It has been announced that in the event of the final loss of the McGraw-Fiske suit, involving $1,500,000, bequeathed to the library of Cornell, Mr. Henry W. Sage of Ithaca would pay for the library building, to cost over $200,000, on which work has begun. But it has not been made public till now, that, in addition to standing the cost of the building, Mr. Sage offers, if the suit is lost, to give the library an endowment of $300,000. If the McGraw-Fiske suit is won, as is confidently expected, Mr. Sage's half a million will probably come to the university for other purposes. The giving of this sum will make Mr. Sage's benefactions to the university amount to about $1,000,000 in cash, besides counsel and services.

— In the *American Journal of Science* for March, 1887, and the *London, Dublin, and Edinburgh Philosophical Magazine* for the same month, Mr. Henry A. Rowland has published a list of standard wave-lengths, as far as could be observed with the eye, with a few imperfectly observed by photography, the whole being reduced to Bell's and Pierce's values for absolute wave-lengths. Mr. Bell has continued his measurements, and found a slightly greater value for the absolute wave-length of the D line, and Mr. Rowland has reduced his standards to the new values. Nearly the whole list has been gone over again, especially at the ends around the A line and in the ultra-violet. The wave-lengths of the ultra-violet were obtained by photographing the coincidence with the lower wave-lengths, — a method which gives them nearly equal weight with those of the visible spectrum. The full set of observations will be published hereafter, but the present series of standards can be relied on for relative wave-lengths to .02 division of Angström in most cases, though it is possible some of them may be out more than this amount, especially in the extreme red. As to the absolute wave-length, no further change will be necessary, provided spectroscopists can agree to use that of Rowland's table, as has been done by many of them. By the method of coincidences with the concave grating, the wave-lengths have been interwoven with each other throughout the whole table, so that no single figure could be changed without affecting many others in entirely different portions of the spectrum. The principal difference from the preliminary table is in the reduction to the new absolute wave-length, by which the wave-lengths are about 1 in 80,000 larger than the preliminary table. It is hoped this difference will not be felt by those who have used the old table, because measurements to less than .1 division of Angström are rare, the position of the lines of many metals being unknown to a whole division of Angström. As the new map of the spectrum has been made according to this new table, there seems to be no further reason for changing the table in the future. No attempt has been made to reduce the figures to a vacuum, as the index of refraction of air is imperfectly known; but this should be done where numerical relations of time period are desired. In the column giving the weight, the primary standards are marked S, and the other numbers give the number of separate determination of the wave-length, and thus, to some extent, the weight. Many of these standards are double lines, and some of them have faint components near them, which makes the accuracy of setting smaller. This is specially the case when this component is an atmospheric line whose intensity changes with the altitude of the sun. The principal doubles are marked with d; but the examination has not been completed yet, especially at the red end of the spectrum, and a table of the standard wave-lengths is given on p. 78 of the May number of the "Johns Hopkins University Circulars."

— Schneider & Co. of France have recently taken out a patent, as we learn from *The Engineering and Mining Journal*, for manufacturing steel containing a variable portion of copper, which is to be used in making artillery of large caliber, armor-plates, rifle-barrels, and projectiles. Ordinary copper is used for the purpose, care being taken to prevent it from oxidizing before it is mixed with the steel in the crucible; and the composition contains two to four per cent of copper, the alloy being capable of far more resisting power and more elastic and malleable than simple steel would be. This new material will also probably be valuable for making girders for building-purposes and ship-plates.

— Mr. J. S. Ames, in writing of the concave grating in theory and practice, says a word as to the difficulties of ruling gratings, which may explain why so many orders received at the Johns Hopkins University for gratings remain unfilled. It takes months to make a perfect screw for the ruling-engine, but a year may easily be spent in search of a suitable diamond-point. The patience and skill required can be imagined. For the past year, all attempts to find a point for the new ruling-engine have failed; and it is only within a few days that one has been found. Most points make more than one "furrow" at a time, thus giving a great deal of diffused light. Moreover, few diamond-points rule with equal ease and accuracy up hill and down. This defect of unequal ruling is especially noticeable in small gratings, which should not be used for accurate work. Again, a grating never gives symmetrical spectra, and often one or two particular spectra take all the light. This is of course desirable, if these bright spectra are the ones which are to be used. Generally it is not so. These individual peculiarities of gratings were fully treated by Professor Rowland in his lectures during the spring term of 1888, and have been embodied by him in a complete mathematical theory of the grating, which he has nearly ready for publication. It is not easy to tell when a good ruling-point is found; for a "scratchy" grating is

often a good one; and a bright ruling-point always gives a "scratchy" grating. When all goes well, it takes five days and nights to rule a six-inch grating having 20,000 lines to the inch. Comparatively no difficulty is found in ruling 14,000 lines to the inch. It is much harder to rule a glass grating than a metallic one; for to all of the above difficulties is added the one of the diamond-point continually breaking down. For this reason, Professor Rowland has ruled only three glass gratings, one of which has been lost, and the other two are kept in his own laboratory. These two were used by Dr. Bell in his determination of the absolute wave-length of the D lines.

— Among the interesting and successful recent inventions is a rolling-mill for producing sheet metal direct from the molten state, instead of rolling it from a billet or bar. A machine of this character has been at work for several months at the can-factory in Maywood, near Chicago. It is used for making sheet solder, six or eight inches wide, and $\frac{15}{1000}$ of an inch thick, which it produces at the rate of 400 feet a minute. *The Engineering and Mining Journal* describes the apparatus as consisting of hollow rolls with cold water running through them. The water is introduced through the axles, and the rolls are of sufficient size to at once change the jet of melted metal into solid form as fast as it is fed. The powerful compression exerted by rolls upon the molten metal in forcing it between the two surfaces, and at the same time changing it to a solid body, tends to give to the sheet an even and highly finished surface. The inventors of the machine believe that the principle could be successfully applied to the rolling of Bessemer steel, as well as to softer metals. Mr. O. W. Potter, and other officers of the North Chicago Rolling Mill Company, recently examined the machine, and expressed themselves as being favorably impressed with its work.

— The *Railroad Gazette* calls attention to a double locomotive for the Indian State railways which is a novel departure from the common practice. The design is really a permanent double-header; that is, it is intended for use when the conditions are such as to require the use of two locomotives of the ordinary type, continually in tandem. This arrangement removes the necessity for two tenders, and renders easier the transmission of signals from one cab to another. There is nothing in this arrangement to criticise: it is really almost the only plan upon which locomotives of great capacity can be constructed with any approach to a minimum of weight per running foot of track. This general plan is not new in America, however. The well-known William Mason, of the Mason Locomotive Works of Taunton, Mass., constructed locomotives on this general plan many years since; and recently the South Side Rapid Transit Co. of Chicago, while investigating the possibilities of extending the usefulness of the proposed structure in years to come, decided that the adoption of a locomotive of a design similar to the one described above would enable them to haul nearly double the number of cars around the sharpest curves without increasing the load per running foot of the structure. *Engineering*, London, contains further description, together with an inset showing the locomotive quite completely.

— *Garden and Forest* states that in the garden of Professor Charles N. Shepard, Charleston, S.C., is a rose remarkable for its size and vigor. The original stock, a Banksian rose, was planted more than fifty years ago; but, at heights varying from ten to fifteen feet, grafts of Maréchal Neil, Marie Van Houtte, Devoniensis, Cloth of Gold, Madame Eugenie Verdier, and other choice varieties, have been inserted, and these have made wonderful growth. The trunk at the base is nearly a foot and a half in diameter; and the branches cover two trellises, each some forty feet long and twelve feet wide, besides rioting over a piazza sixty-five feet long and forty-five feet high, while the topmost shoots are aspiring to cover the roof. From a photograph it can be seen that this great vine was thickly covered from bottom to top with finely developed flowers.

— Our own missionaries in China frequently allude to cases of opium-poisoning, says *The Missionary Herald*. They are often summoned in haste to treat those who have by this method attempted suicide. Rev. Mr. Dixon, a missionary of the English Baptist Mission at Tai-yuen-fu, reports, that, during the three years he has been connected with the mission, he has attended some thirty-six cases of attempted suicide by opium. He affirms that nine out of every ten men and women smoke the drug, beginning about twenty years of age, some of them earlier. The excess in this indulgence is such as to impoverish the people, and the poor wretches who are unable to obtain the supply they crave often end their sufferings by borrowing enough to destroy life. In Mr. Dixon's list of cases, there are young men and old men, girls and wives, beggars and officials. One of the occasions which frequently leads to this rash step is anger which has been excited by some trivial circumstance. Opium is an awful scourge in China, and brings in its train innumerable evils, of which, perhaps, opium suicide is not the worst.

— Four locomotives to be run by soda, which takes the place of fire under the boiler, have been built in Philadelphia, says the *Railway Age*, for service on the streets of Minneapolis, Minn., where steam-engines are forbidden. The engine is about sixteen feet long, entirely boxed in, with no visible smoke-stack or pipes, as there is no exhaust or refuse. The boiler is of copper, eighty-four and one-half inches in diameter and fifteen feet long, having tubes running through it as in steam-boilers. Inside the boiler will be placed five tons of soda, which, upon being dampened by a jet of steam, produces an intense heat. In about six hours the soda is thoroughly saturated, when the action ceases. A stream of superheated steam from a stationary boiler is then forced through the soda, which drives out the moisture, and the soda is ready for use again. The exhaust steam from the cylinders is used to saturate the soda, and by this means all refuse is used. These engines are the first of their kind that have been built in this country. They will have the same power as those used on the New York elevated roads. Soda-engines are used in Berlin and other European cities very successfully, and they also traverse the St. Gothard Tunnel, under the Alps, where the steam-engines cannot be used, because the tunnel cannot be ventilated so as to carry off the noxious gases generated by a locomotive.

— In 1864 a hot-headed French inventor offered to contract for churches and cathedrals, including a peal of bells, says *The Paper Makers' Circular*, to be constructed entirely of paper. From chimes to cannons was but one step, and the Gallic inventor announced his readiness to supply a train of artillery of any given caliber, made of the same material. Building-paper is enjoying a perfect boom just now, and is proving a fine material in the hands of architects and builders for several uses, inside and out. The advantages, briefly stated, are: continuity of surface, or its adaptability for making into rolls of almost any width and length, and flexibility; or by glueing several layers together it may be made stiff, and will stop the passage of air because of the absence of joints; unlike wood, it has no grain, and will not split; it is unaffected by change of temperature, and thus has an advantage over sheet-metal for roofing materials; though in its natural condition it is affected by moisture, it can be rendered waterproof by saturating with asphalt or by various other methods; being a non-resonant body, it is well fitted to prevent the passage of sound; it is a non-conductor of heat, and can also be made of incombustible material, like asbestos, or rendered resistant to fire by chemical treatment.

— The electrical census machine is described as follows in *The Engineering and Mining Journal:* "The census-collector will call with his printed blank, and answers to questions will be written in the usual way. These sheets will then be placed before a person who operates a machine which may be likened to a typewriter, except, that, instead of the usual ink-mark on paper, small round holes are punched in a card. The cards, one for each person, are about 6½ inches in length by 3 inches in width, and the particular position of a hole in a card indicates an answer to some of the questions in the printed blank. As many as 250 items of information can be punched out upon a card, although no one card would ever have more than one-tenth part of the whole number: as, for example, no one person can be classed as both white and black, American and foreign born, and if foreign born he can only come from one country. These cards, when punched, are placed one at a time in a sort of press, and a lever operated by one hand is brought down, when a series of pins are brought against the

card. Whenever a hole has been punched in a card, the corresponding pin passes through into a mercury-cup beneath, completing an electric circuit. These circuits, one for every hole, pass out to a large number of counters which operate electrically, and which add upon their dials all items of the same kind upon the same dials: as, for instance, all white men upon a dial marked "white males;" all business or professional people, upon dials which indicate their particular business or profession. The cards, as they leave the press, are all sorted by means of an electrical sorting device, whereby they may be separated into groups or States of the Union. It will thus be seen that the machines are much more reliable than the most accurate human agency, and that one machine will do the work of a large number of clerks. The next census of this country will be taken with these machines, and two will be sent to New York soon for the 1890 census-taking."

—The report of the royal commission appointed to consider the expediency of establishing a teaching university for London has been laid on the table of the House of Commons, and *Nature* states that the Blue Book may be expected soon. The commissioners are agreed, first, that the petition of the Royal Colleges of Physicians and Surgeons to be authorized to grant degrees in medicine should not be entertained; second, that it is desirable that London should have a teaching university. On the third point — whether a charter shall be granted to the associated colleges of King's and University, constituting these colleges the Teaching University of London — the commission are divided. The three commissioners connected with the teaching profession (Sir William Thomson, Professor Stokes, and Mr. Welldon) are in favor of it; the three lawyers (Lord Selborne, Sir James Hannen, and Dr. Ball) are opposed to it. The report ends with a request that this question be referred back to the commission for their further consideration, in order that they may determine whether it is not possible to devise a scheme of common action between the two colleges and the existing University of London.

— The Swedish Government has decided, *Nature* announces, to send a man-of-war to New York to bring home the body of Capt. Ericsson, who expressed a strong desire to be buried at Langbanshyttan, in Vermeland, the place of his birth. In his will no directions are given as to the disposal of his valuable collection of models, but Swedish journals state that the executors will present them to the Smithsonian Institution.

— According to *Allen's Indian Mail*, the Madras Museum now possesses the skeleton of the largest elephant ever killed in India. This elephant was the source of great terror to the inhabitants of South Arcot, by whom it was killed and buried. The museum authorities despatched a taxidermist to the spot to exhume the bones and transfer them to Madras. The skeleton is exactly 10 feet 6 inches in height, being 8 inches higher than the highest hitherto measured in the flesh by Mr. Sanderson.

— The Upsala University and the Swedish Geographical Society have sent Dr. Carl Forsstrand to study the marine fauna of the West Indian Islands during the present summer.

— Mr. Chardonnet has succeeded in preparing a new artificial silk, — a silk which bears the same relation to the natural article as celluloid does to ivory. Its preparation is somewhat as follows: Cellulose (cotton, or whatever may be available), after being treated with a mixture of nitric and sulphuric acids in equal proportion, as for the making of gun-cotton, is dissolved in a mixture of alcohol and ether, to which is added some perchloride of iron or protochloride of tin and tannic acid. The solution thus obtained is placed in a vertical vessel terminating in a small tube or in a diaphragm pierced with fine holes, so that it can run out into a vessel full of water slightly acidulated with nitric acid. The fine fluid filament which comes out takes on immediately a more or less solid consistency, and forms a thread, which can be wound on a spool. The thread thus obtained resembles silk very closely, and is equally strong and elastic. It is not attacked by water, cold or warm, nor by the acids and alkalies moderately concentrated. By introducing into the solution coloring-materials, one may obtain threads of any desired shade. This artificial silk is said to be extremely inflammable, — an objection which it is hoped to overcome. It is probable that the nitric acid can be replaced by some other which will render it less combustible. When this progress has been realized, we shall have a new textile fabric of the greatest importance.

— Madrid has for a long time shared with St. Petersburg and Buda-Pesth the monopoly of being one of the most unhealthy cities in Europe. From 1880 to 1887 the number of deaths averaged 41.2 per thousand. In 1887, on account of epidemics of scarlet-fever and diphtheria, this figure rose to 45 per thousand. As a result, the public and the authorities have been aroused, and the government has just ordered certain measures to improve the sanitary condition of the city, including improved drainage systems, methods of disinfection, the inspection of the food-supplies, the organization of proper hospitals, etc.

— Laura Bridgman, the famous deaf and blind mute, died May 24 in the Perkins Institution for the Blind in South Boston, of erysipelas, which finally attacked the heart. She had been ill for about three weeks, and retained her consciousness almost unto the last. The story of her afflictions, and of the wonderful way in which she was enabled to triumph over them, had made her name known throughout the civilized world. She was born in Hanover, N.H., Dec. 21, 1829, and, although subject to fits in infancy, was an intelligent and healthy child, with all normal faculties, at two years old. At that time she was prostrated by a fever, which raged for seven weeks, destroying sight and hearing, and blunting the senses of taste and smell. She did not recover her health for two or three years, and was cut off, necessarily, from all ordinary human communication, although she exhibited signs of intelligence, and proved her recognition of different members of her family by certain motions which she herself invented. She was seven years old when she was put under the control of Dr. Samuel G. Howe in the institution of which she remained an inmate for so many years, and her education was begun.

— A writer in the *Pall Mall Gazette* says, that, including five drowning cases, the fatal accidents from all causes in connection with the Forth Bridge amount to 53. As regards those killed in the actual construction of the bridge, there have been 44 lives lost, death taking place either at the time of the accident or soon after. The total number of accidents which had occurred up to September, 1888, — mostly in the four years beginning with September, 1884, — was 543, of which the greater part, of course, were of the description ranging from "serious" to "slight." Of these 543 cases, 84 were treated in hospital, and 459 at the homes of the injured persons. The following hair-breadth escapes are recorded: One man trusted himself to work at a height of 120 feet over the waters of the Firth, simply grasping a rope. His hands got numbed with cold, his grasp relaxed, he fell backwards down, and down, into the water; and he was fished up alive. In another instance a spanner fell a distance of 300 feet, knocked off a man's cap, and fell on the wooden stage at his feet, and went clean through a four-inch plank. In another case somewhat similar, a spanner which fell from a great height actually tore a man's clothes from his waistcoat to his ankle, and left him uninjured. One of the most thrilling incidents heard of was that in which the "staging," or scaffolding on which the men work high up in mid-air, gave way, carrying a number of poor fellows in its fall. Two of these men, striking some portion of the work in their descent, were killed before they reached the water; one or two others who fell clear of the girders were rescued from the Firth little the worse for their fall and immersion; two others, however, managed as they fell to grasp at one of the struts high up above the water, and there they clung for dear life. To effect their rescue was itself an undertaking of no slight danger; but efforts were promptly made, and before long the man who happened to be nearest the rescuer was reached. And this brave fellow, hanging there to the ironwork, actually persuaded the rescuers to delay taking him off before they saved his companion. "Never mind me!" he said: "I can hold a bit longer; go and see to my mate, for he's getting dazed, and he'll drop." We are glad to record that this hero, and his mate too, were saved.